SECTION 16426

LOW VOLTAGE POWER CIRCUIT BREAKER SWITCHGEAR

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NOTE TO SPECIFIER: Refer to LANL Electrical Design Standards, paragraph 242.5, for guidelines on selecting low voltage distribution switchgear. Use this Section for applications where the mains and feeders are greater than 800 amperes (frame size). Use Section 16425 — SWITCHBOARDS where feeders are smaller than 800 amperes (frame size). Use Section 16470 — PANELBOARDS where mains are 800 amperes or less.

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal-enclosed low voltage power circuit breaker switchgear assembly.

1.2 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 - *National Electrical Code*.

B. Furnish products listed and labeled by Underwriters Laboratories, Inc., as suitable for purposes specified and shown.

1.3 SUBMITTALS

A. Provide the following submittals according to the provisions of Sections 01300 and 01700.

B. Certification that products meet or exceed the specified requirements.

C. Catalog data showing compliance with specified requirements.

D. Certification that switchgear will be capable of performing required functions after a design earthquake as specified in 1.8 SERVICE CONDITIONS below. Subject to approval by the University, seismic operating experience data may be used as an alternative to type testing or quantitative analysis where such data have been documented and validated for conditions more severe than those specified in 1.8 SERVICE CONDITIONS below.

E. Shop drawings to include:

1. Master drawing index.

2. Front views and plan view of the assembly.

3. Single line or three line diagrams.

4. Schematic diagrams.

5. Nameplate schedule.

6. Component lists.

7. Conduit space locations within the assembly.

8. Assembly ratings including:

   a. Short circuit rating.

   b. Voltage.

   c. Continuous current.

9. Major component ratings including:

   a. Voltage.

   b. Continuous current.

   c. Interrupting ratings.

10. Cable terminal sizes.

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Edit 11 through 15 to match Project requirements; delete if not needed.
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11. Shipping splits.

12. Busway connection.

13. Connection details between close-coupled assemblies.

14. Composite front view and plan of close-coupled assemblies.

15. Key interlock scheme drawing and sequence of operations.

16. Description of the main-tie-main automatic throw-over system to include components and operating sequences.

F. Wiring diagrams showing device identifications and numbered terminals for power, control, communications and instrumentation systems.

G. Installation instructions, including equipment anchoring requirements to meet the seismic conditions specified in 1.8 SERVICE CONDITIONS. Indicate application conditions and limitations of use stipulated by product testing agency specified under 1.2 Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

H. Time-current curves for low voltage circuit breaker trip units.

I. Operating and maintenance instruction manuals including step-by-step acceptance and maintenance test procedures and a listing of recommended spare parts.

J. Certified production test reports.

K. Letter indicating that manufacturer will issue a one year commercial warranty against defects in material or workmanship when the University has received, inspected and accepted the equipment.

L. Certification by manufacturer's representative that the contractor has installed, adjusted, and tested the equipment according to the manufacturer's recommendations.

1.4 QUALITY ASSURANCE

A. Metal-enclosed low voltage power circuit breaker switchgear assembly manufacturing facility shall be ISO 9001 or ISO 9002 certified and shall have a documented record of at least ten major installations within the last five years.

1.5 MAINTENANCE MATERIALS

A. Furnish any special tools or test equipment required to operate and maintain the equipment.

B. Furnish one spray can of touch-up paint that matches finish for each switchgear assembly. Provide Material Safety Data Sheet (MSDS) for touch-up paint.

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Edit C to match project requirements; delete if there is no automatic throw-over system not needed.

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C. Supply backup copies of automatic throw-over system PLC programming plus software, interface hardware, and passwords required to modify programming or re-load programming.

1.6 EXTRA PRODUCTS

A. Furnish a total of three (3) of each size and type power and control fuse installed in the metal-enclosed low voltage power circuit breaker switchgear assembly.

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Edit B to match project requirements; delete if there is no automatic throw-over system not needed.

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B. Furnish one of each type digital input module and one of each type digital output module for the programmable logic controller (PLC) associated with the automatic throw-over system..

1.7 DELIVERY, STORAGE, AND HANDLING

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Edit A to match project requirements.

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A. Deliver in shipping splits of lengths that can be moved past obstructions in the delivery path.

B. Inspect switchgear assembly upon delivery and report concealed damage to the carrier within their required time.

C. Handle and store switchgear assembly according to ANSI/IEEE C37.20.1 and the manufacturer's instructions.

1. Use factory-installed lifting provisions.

2. Store switchgear assembly in a clean, dry environment. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic. Store switchgear assembly so moisture condensation will not occur on or in the switchgear assembly. Provide temporary heaters as required to prevent condensation.

1.8 SERVICE CONDITIONS

A. Provide electrical equipment and material capable of performing satisfactorily in the following service conditions:

1. Altitude of 7500 feet above sea level

2. Maximum ambient temperature of 104°F

3. Minimum ambient temperature of -20°F

4. 24-hour average temperature not exceeding 86°F

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Edit 5 to match project requirements; use only for outdoor equipment.

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[5. Maximum solar heat gain: 110 W/ft^2]

6. Load current harmonic factor not exceeding 5% THD.

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Edit 7 to match project requirements. Use peak accelerations as follows for equipment mounted at grade: 0.2g for PC-1 facilities, 0.2g for PC-2 facilities, 0.31g for PC-3 facilities. Refer to Table 2-5 of DOE STD 1020 for "importance factors". Consult a structural engineer for equipment at other than grade.

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7. Provide switchgear assembly suitable and certified to meet all applicable seismic requirements of the Uniform Building Code for zone 2B application.

a. Provide guidelines for installation and seismic anchoring based on testing of representative equipment.

b. The test response spectrum shall be based upon a 5% minimum damping factor, a peak of [0.2g][0.2g][0.31g]. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

PART 2 PRODUCTS

2.1 METAL-ENCLOSED LOW VOLTAGE POWER CIRCUIT BREAKER SWITCHGEAR ASSEMBLY

A. Manufacturers:

1. Square D Company, POWER ZONE III

2. Westinghouse/Cutler-Hammer, Type DSII

3. Siemens Energy & Automation, Inc., Type R

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Edit B to match project requirements.

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B. Provide UL labeled [indoor] [outdoor, walk-in], metal-enclosed low voltage power circuit breaker switchgear assembly that meets the requirements of ANSI/IEEE C37.20.1 — *Standard for Metal-Enclosed Low-Voltage Power Circuit Switchgear* and UL Standard 1558 — *Low Voltage Power Circuit Breaker Switchgear* and has the following ratings:

1. Operating Voltage: 480Y/277 volts

2. Rated Maximum Voltage: 635 volts (RMS)

3. Rated Frequency: 60 Hz

4. Rated Insulation Level: 2.2 kV (RMS)

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Edit 5 to match project requirements; main bus rating need not exceed main breaker frame size.

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5. Main Bus Rated Continuous Current: [1600] [2000] [3200] [4000] amperes. [As scheduled on the Drawings.]

6. Neutral Bus Rated Continuous Current: 100% of the main bus rating.

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Edit 7 to match project requirements; rated short time current need not be greater than the corresponding rating of the main circuit breaker.

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7. Rated Short Time Current: [50,000] [65,000] amperes (RMS symmetrical)

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Edit 8 to match project requirements; rated short circuit current need not be more than the corresponding rating of the main circuit breaker.

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8. Rated Short Circuit Current: [50,000] [65,000] amperes (RMS symmetrical)

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Edit C to match project requirements.

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[C. Provide metal-enclosed low voltage power circuit breaker switchgear assembly suitable for use as service entrance equipment and so labeled according to UL requirements.]

D. Fabricate enclosure frame, internal barriers and outer panels following ANSI/IEEE C37.20.1. Finish interior panels and barriers with light or medium gray paint applied over a rust inhibiting phosphate primer. Enclosure construction shall prevent entry of rodents and reptiles into the switchgear interior. Provide hinged doors where rear access is required.

E. Use Type SIS or equivalent high temperature wire for control and communications wiring. Secure wires in bundles using nylon ties; anchor bundles to the switchgear assembly using pre-punched wire lances. Connect current transformer secondary leads to accessible short-circuiting terminal blocks before connecting to any other device. Terminate control and communications conductors on terminal blocks with suitable numbering strips; use crimp-on solderless lugs. Provide wire markers at each end of all control and communications wiring

F. Mount prominent nameplates on the front of the switchgear assembly showing equipment designation, ratings, manufacturer identification, reference serial numbers, and special operations instructions such as for key interlocks.

G. Fabricate main, riser, run-back, neutral and ground busses from copper, with joints silver plated and joined with SAE grade 5 bolts and Belleville type spring washers.

H. Provide NEMA 2-hole compression type lugs for 100 amperes and greater line, load and ground terminations suitable for copper cable rated for 75 degrees C of the size indicated on the drawings. Provide mechanical type lugs for terminations less than 100 amperes. The termination system shall be such that no additional cable bracing, tying or lashing is required to maintain the short circuit withstand ratings of the assembly through 65kA.

I. Provide grounded metal barriers separating the main bus from the rear cable compartment, separating the rear cable compartments in adjacent sections, and isolating the incoming line connections from the main horizontal and vertical bus.

2.2 POWER CIRCUIT BREAKERS

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Edit A to match project requirements.

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A. For main [, tie] and feeder overcurrent devices provide UL labeled draw-out type low voltage AC power circuit breakers. Each circuit breaker shall meet the requirements of ANSI/IEEE C37.13 — *Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures*, ANSI C37.16 — *Preferred Ratings, Related Requirements, and Application Recommendations for Low Voltage AC Power Circuit Breakers*, and UL 1066 — *Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.* Provide circuit breakers with the following ratings:

1. Operating Voltage: 480Y/277 volts

2. Rated Maximum Voltage: 635 volts (RMS)

3. Rated Frequency: 60 Hz

4. Rated Continuous Current: as scheduled on Drawings

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Edit 5 to match project requirements. Include all circuit breaker frames that will be furnished.

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5. Rated Short Time Current at 480 volts:
[800 amp frame, 30,000 amperes (RMS symmetrical)]
[1600 amp frame, 50,000 amperes (RMS symmetrical)]
[2000 amp frame, 65,000 amperes (RMS symmetrical)]
[3200 amp frame, 65,000 amperes (RMS symmetrical)]
[4000 amp frame, 85,000 amperes (RMS symmetrical)]

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Edit 6 to match project requirements. Include all circuit breaker frames that will be furnished.

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6. Rated Short Circuit Current at 480 volts:
[800 amp frame, 30,000 amperes (RMS symmetrical)]
[1600 amp frame, 50,000 amperes (RMS symmetrical}]
[2000 amp frame, 65,000 amperes (RMS symmetrical)]
[3200 amp frame, 65,000 amperes (RMS symmetrical)]
[4000 amp frame, 85,000 amperes (RMS symmetrical)]

7. Rated Control Voltage: 120 volts

B. Provide manually operated breakers unless electrically operated is indicated on the drawings.

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Edit C to match project requirements; coordinate with Drawings; delete if not needed. Specify electrically operated circuit breakers only where remote opening and closing is required.

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C. Provide electrically operated circuit breakers complete with [120 Vac] [48 Vdc] [125 Vdc] [250 Vdc] operators, [open/close pushbuttons] [control switch], plus red and green indicating lights to indicate breaker contact position], [DC source shall be supplied from a remote battery system] [AC source shall be taken from a (remote source) (control power transformer internal to the switchgear assembly)].

D. Provide each circuit breaker with means for padlocking open to prevent manual or electric closing. The padlocking shall also secure the breaker in the connected, test, or disconnected position.

E. Identify each circuit breaker with a unique serial number visible on the front of the device.

F. Provide circuit breaker manual trip devices that are recessed or otherwise protected to prevent accidental operation.

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Edit G to match project requirements; coordinate with Utilities; delete if not needed.

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[G. Provide cubicle mounted auxiliary switch for remote monitoring of the OPEN or CLOSED position of the main [and tie] circuit breaker[s] by the utility SCADA system.]

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Edit H to match project requirements; use for double ended switchgear assemblies with main-tie-main control systems; delete if not needed.

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[H. Remove manual close devices from main and tie circuit breakers.]

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Edit I to match project requirements.

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I. Provide main [, tie] and feeder circuit breaker trip units that are UL listed, true RMS sensing, microprocessor based devices capable of remote monitoring and control over a twisted pair communications network. Each circuit breaker trip unit shall meet the requirements of ANSI C37.17 — *Standard for Trip Devices for AC and General Purpose DC Low-Voltage Power Circuit Breakers* and shall have the following functions as indicated on the Drawings:

1. Protection: Long time, short time (with and without I^2T, field selectable), instantaneous and ground fault (with and without I^2T, field selectable)

2. LED Indications: Mode of trip and unit status.

3. Display: Alphanumeric display of phase and ground amperes, cause of trip, fault current, peak demand, present demand, energy consumption, and service messages.

4. Testing: Simulated testing of all protection functions

5. Communications: Breaker status (open/closed/tripped), cause of trip, time of trip, current at time of trip, RMS currents per phase and ground, peak demand, present demand, energy consumption.

6. Metering display accuracy of the complete system shall be +/- 2% of full scale for current values, +/- 3% of full scale for power values, +/- 4% of full scale for energy values.

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Edit 7 to match project requirements.

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7. Zone Selective Interlocking: Capability for interlocking both short-time and ground-fault time delays with upstream and downstream devices so the circuit breaker closest to the fault trips with no delay. Implement the zone selective interlocking between main and feeder circuit breakers within the metal-enclosed low voltage power circuit breaker switchgear assembly.

J. Provide a removable and sealable transparent cover for trip unit adjustments and rating plug to comply with NFPA 70, Section 240-6(b).

K. Completely equip breaker cells indicated as SPACE on the Drawings for the future insertion of circuit breakers with features specified in this Section.

2.3 ACCESSORIES

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Edit A to match project requirements; coordinate with Drawings; delete if not needed.

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[A. Provide key interlock systems to accomplish the following functions:]

[1. Prevent operation of the secondary unit substation primary switch if the 480Y/277 volt main circuit breaker is closed.]

[2. Prevent paralleling of electrical sources through the main circuit breaker and future second source main breaker.]

[3. Prevent closing tie circuit breaker if both main circuit breakers are closed.]

[4. Prevent closing both main circuit breakers unless tie circuit breaker is open.]]

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Edit B to match project requirements; coordinate with Drawings; usually needed for main-tie-main automatic throw-over systems; delete if not needed.

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[B. Provide truck operated cell switch[es] to indicate racking position of the main [and tie] circuit breaker[s].]

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Edit C to match project requirements; coordinate with Drawings; delete if not needed.

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[C. Design grounding of system neutral in the switchgear [for double-ended arrangement.] [to facilitate future conversion of the switchgear to a double-ended arrangement.]]

D. Provide a copper ground bus firmly secured to each vertical section structure and extending the entire length of the switchgear. The ground bus short time withstand rating shall meet that of the largest circuit breaker within the assembly.

E. Provide a track type, top mounted breaker hoist.

F. Provide each circuit breaker cell with a hinged outer steel door with padlocking provisions.

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Edit G to match project requirements; coordinate with Drawings.

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G. Provide transformer[s] with primary and secondary fuses to provide 120 volt control power as required by: metering and monitoring system; [outdoor enclosure lights, receptacles and strip heaters;] [and adequate power for transformer cooling fans]. Provide fuses with blown-fuse indicators while fuse is installed in the fuse mounting.

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Edit H to match project requirements; coordinate with Drawings; delete if not needed.

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[H. Provide a bus transition section to interface with the existing _____/_____ kVA (AA/FA) [liquid filled] [dry-type] transformer[s]. Transformer[s] was [were] manufactured by _____ and is [are] shown on manufacturer's shop drawing number _____, dated _____.]

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Edit I to match project requirements; delete if not needed.

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[I. Provide a mimic bus, showing bussing, connections and circuit breakers on the front panels of the switchgear. Use 0.75 inch wide, 7 mil thick white vinyl plastic tape with rubber-based adhesive.]

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Edit J to match project requirements; use for double ended switchgear assemblies; delete if not needed.

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[J. Provide modified differential ground fault sensing and interruption system for main and tie circuit breakers.]

K. In service entrance switchgear, provide UL listed secondary surge arresters that comply with ANSI/IEEE C62.11 — *IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits* and are rated for “location category C” as defined in ANSI/IEEE C62.41 — *IEEE Guide for Surge Voltages in Low-Voltage AC Power Circuits*. Connect arrester leads to the switchgear main bus using subfeed lugs or other means to provide disconnecting arrester without introducing excessive impedance.

2.4 METERING

A. Provide current transformers and fused potential transformers, conforming to ANSI C57.13, accuracy class 0.3, of suitable ratio and burden for specified metering and monitoring system on the main bus. Fuses shall have a blown-fuse indicator with visible evidence of fuse operation while installed in the fuse mounting.

B. Provide semi-flush mounted voltage and current test switches in instrument transformer circuits to facilitate external connection of portable specialized metering equipment to monitor the main bus.

C. For each main circuit breaker, provide one addressable microprocessor-based device for switchgear main bus metering. Device shall be UL listed.

1. The device shall display the following metered values on a faceplate alphanumeric readout and shall auto range between Units, Kilo-Units, and Mega-Units; the information shall be also available at a remote computer or PLC through the twisted pair communications network:

RMS Current:	±0.2% Accuracy, Phase A, Phase B, Phase C, Neutral.
Voltage:	±0.2% Accuracy, Phase A-B, Phase A-Neutral, Phase B-C, Phase B-Neutral, Phase C-A, Phase C-Neutral.
Real Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, Total.
Reactive Power:	±0.4% Accuracy, Phase A, Phase B, Phase C, Total.
Power Factor:	±0.8% Accuracy, Phase A, Phase B, Phase C, Total.
Frequency:	±0.4% Accuracy.
Power Demand:	±0.4% Accuracy, Three Phase.
Energy:	±0.4% Accuracy.
Current %THD:	Phase A, Phase B, Phase C, Neutral.
Voltage %THD:	Phase A-B, Phase A-Neutral, Phase B-C, Phase B-Neutral, Phase C-A, Phase C-Neutral.
K-Factor:	Phase A, Phase B, Phase C.
Alarms:	Phase Loss (Voltage), Phase Loss (Current), Phase Unbalance (Voltage), Phase Reversal (Voltage), Overvoltage (selectable percentage and time delay), Undervoltage (selectable percentage and time delay).

2. The device shall make the following additional information available at a remote computer or PLC through the twisted pair communications network:

Waveform Capture:	Through 31st harmonic
Event Capture:	8-Cycles
Trend Logging:	Maximum and minimum of each metered value with date and time of occurrence, Peak power demand with date and time of occurrence.

3. Device shall be programmable to operate up to four Form C (NO/NC) output contacts in response to selected alarm conditions.

2.5 COMMUNICATIONS NETWORK

A. Provide a twisted pair communications network in the metal-enclosed low voltage power circuit breaker switchgear assembly connecting the following:

1. Addressable trip unit in each draw-out circuit breaker

2. Addressable microprocessor-based device for switchgear metering

3. Addressable relays for monitoring the automatic throw-over system.

B. Provide network interface hardware so that the communications network in the switchgear is prepared to communicate with a remote PC over a twisted pair communications network.

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Edit 2.6 to match project requirements; coordinate with Drawings; delete if not needed. This specification describes a two-source, three breaker system used in a double-ended unit switchgear for a critical facility. Less critical facilities may not require the closed transition operating sequence described in paragraph 2.3-I. Other switchgear configurations, such as those with secondary tie circuits to separate switchgear, will require different automatic throw-over system specifications.
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2.6 AUTOMATIC THROW-OVER SYSTEM

A. Provide a two-source, three-breaker automatic throw-over control system in the double-ended metal-enclosed low voltage power circuit breaker switchgear assembly for the automatic operation of main and tie circuit breakers.

B. Furnish control system with programmable logic controller (PLC), uninterruptible power source (UPS), control power transfer relays, control switches and indicator lights to accomplish the required functions.

C. Provide a PLC to control the automatic throw-over system.

1. Provide PLC that will retain programming and data through power interruptions of four months duration.

2. Provide PLC with redundant power supplies for increased reliability. Power supplies shall meet IEEE 587, Category B requirements for surge voltage protection.

3. Provide digital input modules with not less than 2500 VRMS isolation between input terminals and logic. Each input channel shall have two LED indicators: an input LED that illuminates when the input receives an ON signal; a logic LED that illuminates when the input is correctly converted to a processor level logic signal.

4. Provide digital output modules with not less than 2500 VRMS isolation between input terminals and logic. Each output channel shall have three LED indicators: a logic LED that illuminates when module receives an ON signal from the processor; a load LED that illuminates when the output voltage is provided at the output terminals; a blown fuse LED that illuminates when a blown fuse is detected. Digital output modules shall contain a field replaceable fuse for each channel.

5. Fully document the automatic throw-over control system programming in the O&M manual. Supply backup copies of programming plus software, interface hardware, and passwords required to modify programming or re-load programming as O&M material. Provide detailed procedures for functional testing of the automatic throw-over system.

D. Provide an on-line type UPS with 10 minutes of battery back-up time to power the automatic throw-over system.

E. Provide automatic control power transfer relays to transfer control power bus from one control power source to the second when the first is de-energized.

F. Provide a control panel, located on a cell door above the tie circuit breaker, with the following features:

1. A circuit breaker control switch for each main and tie circuit breaker for manual tripping and closing.

2. Three indicator lights with legend plates above each circuit breaker control switch to indicate open (green), closed (red) and tripped on overcurrent (yellow).

3. Key operated manual-maintenance-automatic operating mode selector switch.

4. Three operating mode indicator lights: manual (red, flashing), maintenance (yellow, flashing), automatic (green) with legend plates.

5. Key operated test switch to simulate loss of voltage on either source and to permit testing of the complete automatic throw-over control system.

6. Two source available indicator lights (green) with legend plates.

7. Two control power transfer position indicator lights (amber) with legend plates.

8. Indicator lights shall be push-to-test LED pilot lights.

G. Furnish solid-state, draw-out case mounted protective relays that conform to the requirements of ANSI/IEEE C37.90 — *Relays and relay Systems Associated with Electric Power Systems* as follows:

1. Two 3-phase ANSI device type 47 voltage phase sequence relays that respond to phase failure, phase unbalance and reversed phase sequence.

2. One single-phase ANSI device type 25 synchronism-check relay to determine that proper phase angle and voltage exist.

H. Provide the following open transition operating sequence for the control system in the automatic mode:

1. Normal configuration: both main circuit breakers closed and the tie circuit breaker open.

2. Upon phase reversal or loss of phase-to-phase voltage of either source to 70% of nominal, and after a time delay of 1 second (adjustable from 0.1 to 10 seconds), open the main circuit breaker corresponding to the failed source then immediately close the tie circuit breaker if voltage is available at the other main circuit breaker.

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Edit 3 to match project requirements; coordinate with Drawings.

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3. After the above operation and when the failed source has been restored to normal and synchronism check is maintained for 5 seconds (adjustable from 0.1 to 10 seconds, [automatically] [permit manual controls to] make a closed transition re-transfer: close the main circuit breaker corresponding to the restored source then immediately open the tie circuit breaker. Automatic, open transition, retransfer shall occur without time delay in the event of phase reversal or loss of phase-to-phase voltage on the source feeding the closed main circuit breaker.

4. Include provisions to prevent automatic throw-over under the following conditions:

a. Simultaneous failure of both sources.

b. If a main or tie circuit breaker has tripped due to overcurrent or ground fault.

c. If tie circuit breaker is in the test or disconnected position.

d. If mode selector switch is in the manual or maintenance position.

5. When in the automatic mode, disable the breaker control switches.

I. Provide the following closed transition operating sequence for the control system in the maintenance mode:

1. Normal configuration: both main circuit breakers closed and the tie circuit breaker open.

2. Operating the control switch for either main circuit breaker shall, after synchronism check, close the tie circuit breaker then immediately open the main circuit breaker corresponding to the control switch.

3. After the above operation, operating the control switch for the tie circuit breaker shall, after synchronism check, close the open main circuit breaker then immediately open the tie circuit breaker.

4. Include provisions to prevent the above maintenance mode operations under the following conditions:

a. If main or tie circuit breaker has tripped due to overcurrent or ground fault.

b. Phase reversal or loss of phase-to-phase voltage of either source.

c. If main or tie circuit breaker is in the test or disconnected position.

J. Provide the following operating sequence for the control system in the manual mode:

1. Normal configuration: both main circuit breakers closed and the tie circuit breaker open.

2. Operating the control switch for either main circuit breaker shall open or close the main circuit breaker corresponding to the control switch.

3. Operating the control switch for the tie circuit breaker shall close or open the tie circuit breaker.

4. In the manual mode, electrically interlock the main and tie circuit breakers to prevent paralleling of sources.

K. Provide an engraved nameplate, red background with white lettering, with operating procedures for the automatic throw-over control system.

L. Provide dry contact outputs indicating the following conditions; connect contacts to the switchgear communications network through addressable relays.:

1. Mode selector switch in automatic position.

2. Mode selector switch in maintenance position.

3. Mode selector switch in manual position.

4. PLC run.

5. PLC error or halt.

6. PLC battery low.

7. UPS normal.

8. UPS on battery.

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Edit 2.7 to match project requirements; coordinate with Drawings; delete if not needed.
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2.7 OUTDOOR ENCLOSURE

[A. Provide walk-in outdoor enclosure with the following features:

1. Full length 3'-6" wide interior aisle.

2. Access/exit doors with panic hardware at each end of aisle.

3. Hinged access doors with tamper-resistant hardware and pad-lockable handles at the rear of each switchgear section.

4. Fluorescent lighting providing 30 vertical footcandles on face of switchgear 3 ft above floor.

5. One duplex convenience outlet per 10 feet of length.

6. Thermostat controlled breaker cell strip heaters.

7. Removable steel coverplates over bottom conduit entrance areas.

8. ANSI #49 interior paint finish.

9. ANSI #61 exterior epoxy paint finish to match University standard utility color, Fawn #3604.]

2.8 FACTORY TESTS

A. Perform factory production tests that conform to ANSI C37.20.2, ANSI C37.50—*Test Procedures for Low-Voltage AC Power Circuit Breakers Used in Enclosures*. Provide certification of design tests and other tests conforming to ANSI/IEEE C37.20.2, ANSI C37.50 and ANSI C37.51—*Standard for Conformance Testing of Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies*.

B. Set the circuit breaker trip units and current sensor taps to values scheduled on the Drawings. Test calibration of trip units and associated current sensors by primary current injection into each breaker pole, one pole at a time.

C. Make performance tests of the switchgear assembly ground fault protection systems by primary current injection into each breaker pole, one pole at a time. Include neutral sensor in test circuit.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing conditions are suitable for the installation before beginning work.

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Edit 3.2 to match project requirements; delete if not needed.
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[3.2 SCHEDULING

A. Coordinate and schedule installation of the metal-enclosed low voltage power circuit breaker switchgear assembly with Facility Manager through the Project Leader.

B. Schedule work on weekends and holidays to reduce interruption of User operations.

C. Coordinate switching of 15kV circuits with University utilities service contractor through the Project Leader.]

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Edit 3.3 to match project requirements; coordinate with Drawings; delete if not needed.
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[3.3 DEMOLITION

A. De-energize, disconnect and remove existing low voltage switchgear sections as shown on the Drawings.]

3.4 INSTALLATION

A. Install metal-enclosed low voltage power circuit breaker switchgear assembly by ANSI/IEEE C37.20.1 and the manufacturer's instructions.

B. Provide all necessary hardware required to secure the assembly in place.

C. Install a concrete pad under each metal-enclosed low voltage power circuit breaker switchgear assembly to provide a smooth, level mounting surface. The pad must be level to within 1/8 inch per 3-foot distance in any direction. Refer to Section 16190 - ELECTRICAL SUPPORTING DEVICES.

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Edit D to match project requirements; coordinate with Drawings; delete if not needed.
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D. Install floor steel in the concrete pad under indoor metal-enclosed low voltage power circuit breaker switchgear. Use 4 inch, 5.4 lb./ft. structural steel channel for floor steel. Place in concrete pad at locations recommended by switchgear manufacturer. Use Nelson studs on 12 inch centers to anchor floor steel in concrete pad. Set front and rear channels level and aligned with each other. Set channels level over their entire length. Set top of channels 1/8 inch higher than top of the concrete pad.

E. Furnish and install seismic anchoring following manufacturer's installation instructions.

F. Terminate conduits in the switchgear section containing the corresponding device. Use plugged couplings set flush with the top of the concrete pad. After switchgear is set in place, extend conduits to 1-1/4 inch above the pad and terminate with insulated grounding bushings.

G. Ground the metal-enclosed low voltage power circuit breaker switchgear according to the requirements of Section 16450 — Secondary Grounding.

H. Tighten electrical connectors and terminals, including bus bar and grounding connections, according to the manufacturer’s published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

I. Train conductors neatly in groups; bundle and wrap with cable ties.

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Edit J to match project requirements; coordinate with Drawings; delete if not needed.

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[J. Install zone selective interlock wiring to circuit breakers in other electrical equipment as indicated on the Drawings. Follow switchgear manufacturer's instructions.]

K. Verify that circuit breakers are in the proper cells and that settings of solid state trip devices and current sensor taps match values scheduled on the Drawings.

3.5 IDENTIFICATION

A. Install electrical identification on switchgear and conductors according to Section 16195 ELECTRICAL IDENTIFICATION.

B. Mark floor in front and rear of switchgear to show ANSI/NFPA 70 required working clearances according to Section 16195 ELECTRICAL IDENTIFICATION.

3.6 CLEANING

A. Upon completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.7 MANUFACTURER'S FIELD SERVICE:

A. Provide the services of a factory trained representative from the manufacturer to inspect and certify the installation and to oversee energizing and testing.

B. Manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

C. Provide one full work day of training for up to three owner's representatives at the project site. A manufacturer's qualified representative shall conduct training session. The training program shall consist of instruction on the operation and maintenance of the assembly, circuit breakers, and major components within the assembly.

3.8 TESTING AND ADJUSTING

A. Test the metal-enclosed low voltage power circuit breaker switchgear assembly under the provisions of Section 16950.

END OF SECTION

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<u>NOTE TO DESIGNER</u>: The electrical Drawings pertaining to the metal-enclosed low voltage power circuit breaker switchgear should include the following information:

1. One-line diagram; refer to Drawing ST7002 in the LANL Electrical Engineering Standards manual.

2. Grounding one-line diagram; refer to Drawing ST7003 in the LANL Electrical Engineering Standards manual.

3. Breaker trip unit setting table based on fault current and coordination studies:

a. Circuit number.
b. Load name.
c. Sensor rating (amps) "S".
d. Rating plug (amps) "P".
e. Long time pickup (xP)
f. Long time delay (sec).
g. Short time pickup (xP) (if used).
h. Short time delay (sec) (if used).
I. Instantaneous pickup (xP) (if used)
j. Ground fault pickup (xP)
k. Ground fault delay (sec)
l. Remarks

4. Switchgear plan and elevation.

5. Seismic anchoring details.

6. Communications network diagram showing connection to other equipment and to a facilities operations computer. (If applicable)

7. SCADA riser diagram. (If applicable)

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